CLAIM + DETAILED DESCRIPTION]

[Claim(s)]

[Claim 1] It is the fuel cell system which has the solid polymer type fuel cell which laminates the single battery which has two electrodes which **** an electrolyte membrane and this electrolyte membrane. A fueling means to adjust the pressure of the fuel supplied to this fuel cell while supplying gas-like fuel to said fuel cell. A humidification means to humidify said fuel supplied to said fuel cell, and a current detection means to detect the current outputted from said fuel cell. A fuel cell system equipped with a humidification state judging means to judge the humidification state of said electrolyte membrane based on a resistance detection means to detect resistance of said fuel cell at current *****, and the current detected by said current detection means and the resistance detected by said resistance detection means.

[Claim 2] Said humidification state judging means is a fuel cell system according to claim 1 which is a means to judge the humidification state of said electrolyte membrane based on time change of the value of the resistance detected by said resistance detection means in case the value of the current detected by said current detection means is a predetermined value.

[Claim 3] Said humidification state judging means is a fuel cell system according to claim 2 which is a means to judge that is [humidification of said electrolyte] insufficient when said time change exceeds the predetermined range, and to judge with humidification of said electrolyte being superfluous when said time change is less than said predetermined range.

[Claim 4] It is the fuel cell system which has the solid polymer type fuel cell which laminates the single battery which has two electrodes which **** an electrolyte membrane and this electrolyte membrane. A fueling means to adjust the pressure of the fuel supplied to this fuel cell while supplying gas-like fuel to said fuel cell. A humidification means to humidify said fuel supplied to said fuel cell, and a current detection means to detect the current outputted from said fuel cell. A voltage detection means to detect the voltage outputted from said fuel cell, and an amount change means of fueling to change the amount of supply of said fuel supplied to said fuel cell. A fuel cell system equipped with a humidification state judging means to judge the humidification state of said electrolyte membrane based on the current detected by said current detection means when the amount of supply of said fuel is changed by this amount change means of fueling, and the voltage detected by said voltage detection means.

[Claim 5] [said humidification state judging means] When the amount of supply of said fuel is increased by said amount change means of fueling. The fuel cell system according to claim 4 which is a means to judge the humidification state of said electrolyte membrane based on time change of the value of the voltage detected by said voltage detection means in case the value of the current which came out, exists and was detected by said current detection means is a predetermined value.

[Claim 6] Said humidification state judging means is a fuel cell system according to claim 5

which is a means to judge that is [humidification of said electrolyte] insufficient when said time change exceeds the predetermined range, and to judge with humidification of said electrolyte being superfluous when said time change is less than said predetermined range.
[Claim 7] It is the fuel cell system which has the solid polymer type fuel cell which laminates the single battery which has two electrodes which *** an electrolyte membrane and this electrolyte membrane. A fueling means to adjust the pressure of this fuel supplied to this fuel cell while supplying gas-like fuel to said fuel cell. A humidification means to humidify said fuel supplied to said fuel cell, and a voltage detection means to detect the voltage outputted from said fuel cell. An amount change means of fueling to change the amount of supply of said fuel supplied to said fuel cell, A fuel cell system equipped with a humidification state judging means to judge the humidification state of said electrolyte membrane based on the voltage detected by said voltage detection means before and after changing the amount of supply of fuel by this amount change means of fueling.
[Claim 8] [said humidification state judging means] Before the amount of supply of fuel is increased by said amount change means of fueling, [with said voltage detection means] The fuel cell system according to claim 7 which is a means to judge with humidification being insufficient when the detected voltage is larger than the voltage detected by this voltage detection means after the amount of supply of fuel is increased by this amount change means of fueling
[Claim 9] It is the fuel cell system which has the solid polymer type fuel cell which laminates the single battery which has two electrodes which *** an electrolyte membrane and this electrolyte membrane. A fueling means to adjust the pressure of this fuel supplied to this fuel cell while supplying gas-like fuel to said fuel cell. A voltage detection means to detect the voltage of each battery module which serves as a humidification means to humidify said fuel supplied to said fuel cell from each single battery or the single battery of the same number which constitutes said fuel cell. An amount change means of fueling to change the amount of supply of said fuel supplied to said fuel cell, A fuel cell system equipped with a humidification state judging means to judge the humidification state of said electrolyte membrane based on the variation in the voltage of each single battery detected by said voltage detection means before and after changing the amount of supply of fuel by the amount change means of fueling, or each battery module
[Claim 10] [said humidification state judging means] Before the amount of supply of fuel is increased by said amount change means of fueling, [with said voltage detection means] The variation in the voltage of each detected single battery or each battery module [with this amount change means of fueling] The fuel cell system according to claim 9 which is a means to judge with humidification being superfluous when larger than the variation in the voltage of each single battery detected by this voltage detection means, or each battery module after the

amount of supply of fuel is increased.

[Claim 11] There is no Claim 1 equipped with a humidification control means to control humidification of said fuel by said humidification means based on the judgment by said humidification state judging means, and it is the fuel cell system of a description to either.

[Claim 12] Said humidification control means is a fuel cell system according to claim 11 which is a means to increase the amount of humidification of said fuel by said humidification means when judged with humidification being insufficient by said humidification state judging means.

[Claim 13] Said humidification control means is a fuel cell system according to claim 11 which is a means to increase the pressure of said fuel supplied to said fuel cell by said fueling means when judged with humidification being insufficient by said humidification state judging means.

[Claim 14] Have a working temperature control means to be a fuel cell system according to claim 11 and to control the working temperature of said fuel cell, and [said humidification control means] The fuel cell system which is a means to reduce the working temperature of said fuel cell by said working temperature control means, when judged with humidification being insufficient by said humidification state judging means.

[Claim 15] Said humidification control means is a fuel cell system according to claim 11 which is a means to reduce the amount of supply of said fuel to said fuel cell by said fueling means when judged with humidification being insufficient by said humidification state judging means.

[Claim 16] Said humidification control means is a fuel cell system according to claim 11 which is a means to reduce the amount of humidification of said fuel by said humidification means when judged with humidification being superfluous by said humidification state judging means.

[Claim 17] Said humidification control means is a fuel cell system according to claim 11 which is a means to reduce the pressure of said fuel supplied to said fuel cell by said fueling means when judged with humidification being superfluous by said humidification state judging means.

[Claim 18] Have a working temperature control means to be a fuel cell system according to claim 11 and to control the working temperature of said fuel cell, and [said humidification control means] The fuel cell system which is a means to raise the working temperature of said fuel cell by said working temperature control means when judged with humidification being superfluous by said humidification state judging means.

[Claim 19] Said humidification control means is a fuel cell system according to claim 11 which is a means to increase the amount of supply of said fuel to said fuel cell by said fueling means when judged with humidification being superfluous by said humidification state judging means.

[Claim 20] There is no Claim 11 equipped with a malfunction detection means to detect the malfunction of said fuel cell system when it is judged with the shortage of humidification or humidification being superfluous by said humidification state judging means, in spite of having performed humidification control of said fuel by said humidification control means predetermined time, and it is the fuel cell system of a description to either.

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[Claim 21] The fuel cell system according to claim 20 equipped with an unusual output means to output these abnormalities when said malfunction detection means detects abnormalities.
[Claim 22] The fuel cell system according to claim 20 or 21 equipped with an operation stop means at the time of the abnormalities which stop operation of said fuel cell system when said malfunction detection means detects abnormalities.

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the fuel cell system which has the solid polymer type fuel cell which laminates the single battery which has two electrodes which *** an electrolyte membrane and this electrolyte membrane in detail about a fuel cell system.
[0002]
[Description of the Prior Art] What [judges shortage of the amount of moisture conventionally contained in an electrolyte membrane as this kind of a fuel cell system based on the temperature of a solid polymer type fuel cell and the voltage outputted from a fuel cell], What judges shortage of the amount of moisture contained in an electrolyte membrane based on the temperature of a fuel cell, the current threshold from which the amount of change of the voltage outputted from a fuel cell is drawn as a parameter, and the current outputted from a fuel cell is proposed (for example, JP H7-272738,A etc.). The permission minimum voltage which corresponds from the reaction temperature of the fuel cell detected in this system using the table of the relation between the reaction temperature of a fuel cell and the permission minimum voltage of the voltage outputted from a fuel cell is drawn. As compared with the voltage outputted from a fuel cell by making this into a threshold, when voltage is smaller than a threshold, it has judged with the amounts of moisture contained in an electrolyte membrane being insufficient. Moreover, in the system, the maximum permissible current value is drawn as a threshold by making into a parameter the amount of change of the temperature of a fuel cell, and the voltage outputted from a fuel cell. This threshold is compared with the current outputted from a fuel cell, and when current is larger than a threshold, it has judged with the amounts of moisture contained in an electrolyte membrane being insufficient. And in this system, when judged with the amounts of moisture contained in an electrolyte membrane being insufficient, the current supplied to load is restricted.
[0003]
[Problem to be solved by the Invention] However, in an above-mentioned fuel cell system, since the amount of moisture of the electrolyte membrane was greatly influenced by the temperature of a fuel cell, the pressure of fuel gas, the amount of supply of fuel gas, etc., there was a problem that the accuracy of a judgment of the amount of moisture of an electrolyte

membrane became low. Moreover, in the above-mentioned fuel cell system, when judged with the amounts of moisture of an electrolyte membrane being insufficient, the current supplied to load was restricted, and the electrolyte membrane was protected from the breakage, but there was also a problem that the amount of moisture of an electrolyte membrane could not be made into the suitable range.

[0004] The fuel cell system of this invention is taken as one thing of the purpose for which the humidification state of an electrolyte membrane is judged more correctly. Moreover, the fuel cell system of this invention is taken as one thing of the purpose adjusted so that the humidification state of an electrolyte membrane may become a proper range. Furthermore, when the humidification state of an electrolyte membrane cannot be adjusted the fuel cell system of this invention in the proper range, while judging an unusual, when the abnormality is judged, it is taken also as one thing of the purpose for which an electrolyte membrane is protected from that breakage.

[0005]

[The means for solving a technical problem, and its operation and effect] The fuel cell system of this invention took the following means, in order to attain a part of above-mentioned purpose [at least].

[0006] The 1st fuel cell system of this invention is a fuel cell system which has the solid polymer type fuel cell which laminates the single battery which has two electrodes which *** an electrolyte membrane and this electrolyte membrane. A fueling means to adjust the pressure of the fuel supplied to this fuel cell while supplying gas like fuel to said fuel cell, A humidification means to humidify said fuel supplied to said fuel cell, and a current detection means to detect the current outputted from said fuel cell. Let it be a summary to have a humidification state judging means to judge the humidification state of said electrolyte membrane based on a resistance detection means to detect resistance of said fuel cell of current ****, and the current detected by said current detection means and the resistance detected by said resistance detection means.

[0007] In the 1st fuel cell system of the this invention, a humidification state judging means judges the humidification state of an electrolyte membrane based on the current outputted from the fuel cell detected by a current detection means, and resistance of the fuel cell of current **** detected by a resistance detection means. This judgment is based on resistance of a fuel cell changing with the humidification states of an electrolyte membrane. Let, in addition, what is supplied to either of two electrodes which pinch an electrolyte membrane, and the thing supplied to the both sides of two electrodes are also contained in fuel. The meaning of the fuel is the same also in the fuel of the 4th fuel cell system of the following this invention.

[0008] According to the 1st fuel cell system of such this invention, since it judges based on

resistance of the fuel cell which performs settled directly according to the humidification state of current and an electrolyte membrane supposed from a fuel cell, the humidification state of an electrolyte membrane can be judged more correctly.

[0008] In the 1st fuel cell system of the, the invention, [said humidification state judging means] It shall be a means to judge the humidification state of said electrolyte membrane based on time change of the value of the resistance detected by said resistance detection means to make the value of the current detected by said current detection means a predetermined value. It carries out like this, since it will be judged based on the value of resistance of a fuel cell when making the same current the humidification state of an electrolyte membrane can be judged more correctly. In the 1st fuel cell system of this invention of this mode, said humidification state judging means shall be a means to judge that a [humidification of said electrolyte] insufficient when said time change exceeds the predetermined range, and to judge with humidification of said electrolyte being sufficient when said time change is less than said predetermined range.

[0009] The 2nd fuel cell system of this invention is a fuel cell system which has the solid polymer type fuel cell which laminates the single battery which has two electrodes which sandwich an electrolyte membrane and the electrolyte membrane. A fueling means to adjust the measure of the fuel supplied to the fuel cell while supplying gas-like fuel to said fuel cell, A humidification means to humidify said fuel supplied to said fuel cell, and a current detection means to detect the current outputted from said fuel cell, a voltage detection means to detect the voltage outputted from said fuel cell, and an amount change means of fueling to change the amount of supply of said fuel supplied to said fuel cell. Let it be a summary to have a humidification state judging means to judge the humidification state of said electrolyte membrane based on the current detected by said current detection means when the amount of supply of said fuel is changed by this amount change means of fueling, and the voltage detected by said voltage detection means.

[0010] In the 2nd fuel cell system of this this invention, [a humidification state judging means] The humidification state of an electrolyte membrane is judged based on the current outputted from the fuel cell detected by a current detection means when the amount of supply of the fuel to a fuel cell is changed by the amount change means of fueling, and the voltage outputted from the fuel cell detected by a voltage detection means. This judgment is based on a change of the amount of supply of the fuel to a fuel cell affecting the humidification state of an electrolyte membrane.

[0012] According to the fuel cell system of such this invention, since it judges based on the amount of supply, current, and voltage of fuel to a fuel cell which are the factor which affects the humidification state of an electrolyte membrane, the humidification state of an electrolyte membrane can be judged more correctly.

[0013] In the 2nd fuel cell system of this this invention, [said humidification state judging means] When the amount of supply of said fuel is increased by said amount change means of fueling, it shall be a means to judge the humidification state of said electrolyte membrane, based on time change of the value of the voltage detected by said voltage detection means in case the value of the current which came out, exists and was detected by said current detection means is a predetermined value. If it carries out like this, since it is judged based on time change of the voltage at the time of the same current, the humidification state of an electrolyte membrane can be judged more correctly. In the 2nd fuel cell system of this invention of this mode, said humidification state judging means shall be a means to judge that it is [humidification of said electrolyte] insufficient when said time change exceeds the predetermined range, and to judge with humidification of said electrolyte being superfluous when said time change is less than said predetermined range.

[0014] The 3rd fuel cell system of this invention is a fuel cell system which has the solid polymer type fuel cell which laminates the single battery which has two electrodes which pinch an electrolyte membrane and this electrolyte membrane. A fueling means to adjust the pressure of the fuel supplied to this fuel cell while supplying gas-like fuel to said fuel cell, a humidification means to humidify said fuel supplied to said fuel cell, and a voltage detection means to detect the voltage outputted from said fuel cell, An amount change means of fueling to change the amount of supply of said fuel supplied to said fuel cell. Let it be a summary to have a humidification state judging means to judge the humidification state of said electrolyte membrane based on the voltage detected by said voltage detection means before and after changing the amount of supply of fuel by this amount change means of fueling.

[0015] In the 3rd fuel cell system of this this invention, a humidification state judging means judges the humidification state of an electrolyte membrane based on the voltage outputted from the fuel cell detected by a voltage detection means before and after changing the amount of supply of the fuel to a fuel cell by the amount change means of fueling. This judgment is based on change of the amount of supply of the fuel to a fuel cell affecting the humidification state of an electrolyte membrane.

[0016] According to the 3rd fuel cell system of such this invention, since it judges based on the amount of supply and voltage of fuel to a fuel cell which are the factor which affects the humidification state of an electrolyte membrane, the humidification state of an electrolyte membrane can be judged more correctly.

[0017] In the 3rd fuel cell system of this this invention, [said humidification state judging means] Before the amount of supply of fuel is increased by said amount change means of fueling, [with said voltage detection means] When the detected voltage is larger than the voltage detected by the voltage detection means after the amount of supply of fuel is increased by this amount change means of fueling, it shall be a means to judge with

humidification being insufficient.

[0018] The 4th fuel cell system of this invention is a fuel cell system which has the solid polymer type fuel cell which laminates the single battery which has two electrodes which ... an electrolyte membrane and this electrolyte membrane. A fueling means to adjust the pressure of the fuel supplied to this fuel cell while supplying gas-like fuel to said fuel cell. A voltage detection means to detect the voltage of each battery module which serves as a humidification means to humidify said fuel supplied to said fuel cell from each single battery or the single battery of the same number which constitutes said fuel cell. An amount change means of fueling to change the amount of supply of said fuel supplied to said fuel cell. Let it be a summary to have a humidification state judging means to judge the humidification state of said electrolyte membrane based on the variation in the voltage of each single battery detected by said voltage detection means before and after changing the amount of supply of fuel by the amount change means of fueling, or each battery module.

[0019] In the 4th fuel cell system of this this invention, [a humidification state judging means] The humidification state of an electrolyte membrane is judged based on the variation in the voltage of each single battery which constitutes the fuel cell detected by a voltage detection means before and after changing the amount of supply of the fuel to a fuel cell by the amount change means of fueling, or each battery module. This judgment is based on the humidification state of fuel change of the amount of supply of the fuel to a fuel cell affects the humidification state of an electrolyte membrane and an electrolyte membrane appearing as variation in the voltage of each single battery or each battery module.

[0020] Since it judges based on the voltage of each single battery reflecting the humidification state of the amount of supply of the fuel to a fuel cell, and an electrolyte membrane which is the factor which affects the humidification state of an electrolyte membrane, or each battery module according to the 4th fuel cell system of such this invention, The humidification state of an electrolyte membrane can be judged more correctly.

[0021] In the 4th fuel cell system of the this invention, [said humidification state judging means] Before the amount of supply of fuel is increased by said amount change means of fueling, [with said voltage detection means] The variation in the voltage of each detected single battery or each battery module [with the amount change means of fueling] When larger than the variation in the voltage of each single battery detected by the voltage detection means, or each battery module after the amount of supply of fuel is increased, it shall be a means to judge with humidification being superfluous.

[0022] In the 1st of the 4th fuel cell system of this invention, it shall have a humidification control means to control humidification of said fuel by said humidification means, based on the judgment by said humidification state judging means, including each [these] mode. If it carries out like this, the humidification state of an electrolyte membrane can be adjusted based on the

humidification state of an electrolyte membrane.

[0025] In the 1st or the 4th fuel cell system of this invention equipped with this humidification control means, said humidification control means shall be a means to increase the amount of humidification of said fuel by said humidification means, when judged with humidification being insufficient by said humidification state judging means. It is carried out like this. The shortage of humidification of an electrolyte membrane is conceivable.

[0026] Moreover, in the 1st or the 4th fuel cell system of this invention which it has a humidification control means (said humidification control means) When judged with humidification being insufficient by said humidification state judging means, it shall be a means to increase the pressure of said fuel supplied to said fuel cell by said feeding means. It is carried out like this, since the water vapor pressure in fuel also increases with the increase in the pressure of fuel, the shortage of humidification of an electrolyte membrane is conceivable.

[0027] Furthermore, in the 1st or the 4th fuel cell system of this invention equipped with a humidification control means, have a working temperature control means to control the working temperature of said fuel cell, and (said humidification control means) When judged with humidification being insufficient by said humidification state judging means, it shall be a means to reduce the working temperature of said fuel cell by said working temperature control means if it carries out like this, since the temperature of fuel cell also falls due to the fall of the working temperature of a fuel cell and the water vapor pressure in fuel will increase high in connection with this, the shortage of humidification of an electrolyte membrane is conceivable.

[0028] Or in the 1st or the 4th fuel cell system of this invention which it has a humidification control means (said humidification control means) When judged with humidification being insufficient by said humidification state judging means, it shall be a means to reduce the amount of supply of said fuel to said fuel cell by said feeding means. If it carries out like this, since evaporation of moisture of an electrolyte membrane is controlled with reduction of the amount of supply of fuel, the shortage of humidification of an electrolyte membrane is conceivable.

[0029] In the 1st or the 4th fuel cell system of this invention equipped with a humidification control means, said humidification control means shall be a means to reduce the amount of humidification of said fuel by said humidification means, when judged with humidification being superfluous by said humidification state judging means. It is carried out like this. Overhumidification of an electrolyte membrane is conceivable.

[0030] Moreover, in the 1st or the 4th fuel cell system of this invention which it has a humidification control means (said humidification control means) When judged with humidification being superfluous by said humidification state judging means, it shall be a means to reduce the pressure of said fuel supplied to said fuel cell by said feeding means. It is carried out like this, since the water vapor pressure in fuel also falls with the fall of the pressure

of fuel, overmoistification of an electrolyte membrane is preventable.

[0029] Furthermore, in the 1st or the 4th fuel cell system of the invention equipped with a humidification control means, have a working temperature control means to control the working temperature of said fuel cell, and said humidification control means judges the humidification being sufficient by said humidification state judging means, it shall be a means to raise the working temperature of said fuel cell by said working temperature control means. If it carries out like this, since the temperature of fuel will also rise by the rise of the working temperature of a fuel cell and the water vapor pressure in a fuel will become low in connection with this, overmoistification of an electrolyte membrane is controllable.

[0030] Or in the 1st or the 4th fuel cell system of this invention which it has a humidification control means and humidification control means judges with humidification being insufficiency by said humidification state judging means, it shall be a means to increase the amount of supply of said fuel to said fuel cell by said fueling means. If it carries out like this, since evaporation of moisture of an electrolyte membrane is promoted with the increase in the amount of supply of fuel, overmoistification of an electrolyte membrane is controllable.

[0031] In the 1st or the 4th fuel cell system of this invention equipped with humidification control means including each [these] means in spite of having performed humidification control of said fuel by said humidification control means predetermined time, when it is judged with the shortage of humidification or humidification being superfluous by said humidification state judging means, it shall have a malfunction detection means to detect the malfunction of said fuel cell system. If it carries out like this, the abnormalities of a fuel cell are detectable. In the 1st or the 4th fuel cell system of the invention of this mode, when said malfunction detection means detects abnormalities, it shall have an unusual output means to output these abnormalities. If it carries out like this, the operator can know quickly that abnormalities occurred in the fuel cell. In the 1st or the 4th fuel cell system of the invention equipped with such a malfunction detection means, when said malfunction detection means detects abnormalities, it shall have an operation stop means at the time of the abnormalities which stop operation of said fuel cell system. If it carries out like this, breakage of the fuel cell which may be produced by continuing operation unusually etc., can be prevented.

[0032]

[Mode for carrying out the invention] Next, the form of operation of this invention is explained using a work example. Drawing 1 is the composition figure showing the outline of the composition of the fuel cell system which is one work example of the invention. In that [this] figure, the fuel cell system 20 of a work example [ ] The fuel use fuel tank 22 which supplies the fuel gas containing hydrogen, and the fuel gas humidifier 23 which humidifies the fuel gas supplied from the fuel gas tank 22. The humidification gas tank 24 which supplies the humidification gas for example, air containing oxygen. The humidifier gas humidifier 25 which

humidifier the oxidization gas supplied from the oxidization gas transfer unit 24. It has the solid polymer type fuel cell 30 generated in response to supply with fuel gas and oxidization gas, the cooling device 50 which cools the fuel cell 30, and the electronic control unit 60 which controls operation of the fuel cell system 20.

[0033] the fuel gas feed unit 22 being equipment which supplies the fuel gas containing hydrogen, for example, carrying out property modification of the fuel of hydrocarbon systems, such as methanol and methane, to hydrogen -- it is good also as a property modification machine which supplies rich fuel gas, and good also as a fuel gas storage tank which stores the fuel gas containing hydrogen. It is equipment which supplies the oxidization gas containing oxygen, and the oxidization gas transfer unit 24 is good also as an air pump which only supplies air, and good also as an oxidization gas storage tank which stores oxidization gas other than air. In addition, the fuel gas feed unit 22 and the oxidization gas transfer unit 24 are connected to the electronic control unit 60 with the signal line, and the amount of supply of fuel gas and the amount of supply of oxidization gas are controlled by the electronic control unit 60.

[0034] The fuel gas humidifier 23 and the oxidization gas humidifier 25 are humidifiers which are made to evaporate the water pumped up from the water tank 26, and are supplied to fuel gas or oxidization gas. This fuel gas humidifier 23 and the oxidization gas humidifier 25 are connected to the electronic control unit 60 with the signal line, and the amount of humidification of fuel gas and the amount of humidification of oxidization gas are controlled by the electronic control unit 60.

[0035] The fuel cell 30 is a solid polymer type fuel cell constituted by laminating two or more single batteries 31. The outline composition of the single battery 31 which constitutes the fuel cell 30 is drawing 2 is shown. The electrolyte membrane 32 which is the membrane of proton conductivity with which the single battery 31 was formed of polymer materials, such as fluororesin, so that it may illustrate. The anode 33 and cathode 34 as a gas diffusion electrode which are formed of the carbon cross which the catalyst of the alloy which consists of platinum or platinum, and other metal kneaded, and was scoured round, pinch the electrolyte membrane 32 in respect of the catalyst having kneaded and having been put, and constitute sandwich construction. It is constituted by two separators 35 which make the partition between the single batteries 31 which adjoin while forming the channels 36 and 37 of fuel gas or oxidization gas with an anode 33 and a cathode 34, inserting this sandwich construction from both sides.

[0036] [the fuel cell 30] [the voltage V outputted from the fuel cell 30] [the current I outputted from the voltmeter 40 to detect at the fuel cell 30] The pressure sensor 46 which detects the pressure P of the ammeter 42 to detect, the fuel cell temperature sensor 44 which detects the temperature of the fuel cell 30, fuel gas, and oxidization gas. The resistance detector 48 which

detects the resistance of the fuel cell 20, etc. are attached. These sensors are connected to the electronic control unit 60 by the signal line. Here, when it is doubted or what detects the resistance of the fuel cell 20 from the current value at the time of making a volts alternating current act on the output terminal of the fuel cell 20 is known. Resistance of the fuel cell 20 is divided roughly into the resistance based on resistance of an anode 33, a cathode 34, and a separator 35, and the proton conductivity of the electrolyte membrane 32, [illegible] from the composition of the above-mentioned fuel cell 20. Since the anode 33, the cathode 34, and the separator 35 are formed of a conductive material, they do not change the resistance depending on whether it is humidified or not. On the other hand, proton conductivity changes remarkably by whether the electrolyte membrane 32 is a damp or wet condition. Therefore, the resistance of the fuel cell 20 will reflect the humidification state of the electrolyte membrane 32.

[0037] The regulation-of-pressure valves 27 and 28 are attached to the exhaust pipe of the fuel gas of the fuel cell 20, and oxidization gas, respectively, and the gas pressure of the fuel gas in the fuel cell 20 or oxidization gas can be adjusted now with. In addition, the signal line connects with the electronic control unit 60, and each actuator 27a and 28a of the regulation-of-pressure valves 27 and 28 receive the drive control by the electronic control unit 60.

[0038] The cooling-water pipeline 52 which forms a connection-stream way with the channel of the cold plate with which fuel cell 20 stacks is equipped with the cooling device 50, and the cooling water formed in this cold plate, it has the heat exchanger 56 which is attached to the cooling-water pipeline 52 and cools cooling water by heat exchange with the open air, the pump 54 for cooling water which makes a connection-stream way circulate through cooling water, and the circulating-water-temperature sensor 58 which detects the temperature of the cooling water in near the end of the fuel cell 20 of the cooling-water pipeline 52. The pump 54 for cooling water and the circulating-water-temperature sensor 58 are connected to the electronic control unit 60 by the signal line, and control of cooling of the fuel cell 20 is performed by the electronic control unit 60. That is, the pump 54 for cooling water carries out drive based on the temperature of the cooling water detected by the circulating-water-temperature sensor 58, and control of the circulation flux of cooling water should do.

[0039] The electronic control unit 60 is constituted considering CPU62 as a one-chip microcomputer constituted as a center, and is equipped with RAM66 which memorizes data temporarily in or ROM64 which memorized the processing program, and an input and output port (not shown). [this shows electronic control unit 60.] The voltage V outputted from the [illegible] gauge of the [illegible] supply and [illegible] of fuel gas or oxidization gas, and the fuel gas humidifier 13 which are supplied from the fuel gas feed unit 10 and the oxidization gas transfer unit 24 from the flow instrument which is not illustrated, a thermometer, etc. or the oxidization gas transfer unit 24, and the fuel cell 20 from a voltmeter 46 the current I outputted from the

fuel cell 20 from an ammeter 42. The temperature of the fuel cell from the fuel cell temperature sensor 44, gas pressure [of the fuel gas of the fuel cell 20 from the pressure sensor 46 or oxidation gas] P, resistance of the fuel cell 20 from the resistance detector 48, the temperature of the cooling water from the circulating water temperature sensor 51, etc. are inputted through the input port. Moreover, from the electronic control unit 60, the drive signal to the fuel gas feed unit 22 or the oxidation gas transfer unit 24, the drive signal to the fuel gas humidifier 23 or the oxidation gas humidifier 25, the drive signal to the pump 54 for cooling water, the lighting signal to the indicator, etc. are outputted through the output port.

[0040] Next, operation of the fuel cell system 20 constituted in this way, especially control of humidification of the fuel cell 20 are explained. Drawing 3 is a flow chart which shows an example of the humidification control routine performed by the electronic control unit 60 of the fuel cell system 20 of a work example. This routine is repeatedly performed for every predetermined time until operation is stopped from from immediately after the fuel cell system 20 starts.

[0041] If this humidification control routine is performed, CPU62 will perform processing which judges the humidification state of the electrolyte membrane 32 first (Step S100). Although carried out by the humidification state judging processing routine illustrated in drawing 4 or drawing 7, a detailed explanation of these judgment processings is later mentioned for this judgment processing. In addition, in this judgment processing, "proper humidification", "a shortage of humidification", and "overhumidification" are outputted as a result.

[0042] When the judgment by judgment processing of the humidification state is "proper humidification", counters C1 and C2 are reset (Step S106-S108). When performing processing which cancels the shortage of humidification of the electrolyte membrane 32 at the time of "a shortage of humidification", a counter C1 is incremented (Step S110, S112), while performing processing which cancels overhumidification of the electrolyte membrane 32 at the time of "overhumidification", a counter C2 is incremented (Step S112, S114).

[0043] [here] as processing which cancels the shortage of humidification of the electrolyte membrane 32 [the circulating flow of cooling water with the pressure and the pump 54 for cooling water of the cooling device 50 which lessen the processing and the regulating pressure valves 27 and 29 which increase the amount of humidification of fuel gas or oxidation gas with the fuel gas humidifier 23 or the oxidation gas humidifier 25, and make high gas pressure P of the fuel gas in the fuel cell 20, or oxidation gas] Processing which increases and makes working temperature of the fuel cell 20 low, processing which reduces the amount of supply of the fuel gas supplied to the fuel cell 20 from the fuel gas feed unit 22 or the oxidation gas transfer unit 24 or oxidation gas, etc. are performed. The processing which increases the amount of humidification of fuel gas or oxidation gas among these processings is what cancels the shortage of humidification of the electrolyte membrane 32

the amount of supply of fuel gas or oxidization gas. Thus, the processing which cancels overhumidification of the electrolyte membrane 32 has more than one, and it is good also as what performs one of these processings, and good also as what is performed combining plurality. Moreover, it is good also as what replaces one or more of these processings with one by one, and performs them whenever a humidification control routine is performed.
[0047] A counter C1 is incremented, when the processing which cancels the shortage of humidification of the electrolyte membrane 32 when the humidification control routine of drawing 3 is performed repeatedly is continued and is performed, and it counts the number of times of continuous processing of the processing which cancels the shortage of humidification. A counter C2 counts the number of times of continuous processing of the processing which cancels overhumidification of the electrolyte membrane 32.
[0048] Thus, if processing which cancels the shortage of humidification and overhumidification based on the judgment result of a humidification state of the electrolyte membrane 32 is performed, as for CPU52, either of counter C1 and C2 will judge whether it has become more than the threshold Cref (Step S118). A threshold Cref is set up based on the time required although it can judge that the processing for canceling the shortage of humidification of the electrolyte membrane 32 and overhumidification cannot cut enough, as the number of times of processing. Therefore, when either of counter C1 and C2 is more than the threshold Cref, it judges that abnormalities have occurred in the fuel cell system 20, in order to tell an operator about abnormalities, an indicator 58 is turned on (Step S118), operation of the fuel cell system 20 is stopped for protection, such as the fuel cell 30, (Step S120), and this routine is ended. In addition, any of counter C1 and C2 — although — when it is under the threshold Cref, this routine is ended noting that it cannot judge with abnormalities having still occurred in the fuel cell system 20.
[0049] As explained above, according to the fuel cell system 20 of a work example, based on the judgment result of a humidification state of the electrolyte membrane 32, the humidification state of the electrolyte membrane 32 is controllable by performing the humidification control routine of drawing 3. For example, the shortage of humidification of the electrolyte membrane 32 and overhumidification are cancelable by increasing the amount of humidification of the fuel gas humidifier 23 or the oxidization gas humidifier 25. Moreover, the resistance of the regulator valves 27 and 29 are increased, or the internal gas pressure P of the fuel gas in the fuel cell 30 or oxidization gas can be made high, or it is made low, the water vapor pressure in fuel gas or oxidization gas is fluctuated, and the shortage of humidification of the electrolyte membrane 32 and overhumidification can be canceled. Furthermore, it is made high, and it can be made low circulation flow of cooling water with the pump 56 for cooling water of the cooling device 50 is fluctuated, and the water vapor pressure in fuel gas or oxidization gas can be made high or it low, and the shortage of humidification of the electrolyte membrane 32 and

[illegible]

an ammeter 42 is in agreement with predetermined current Ian (Current I, the processing which reads the voltage V outputted from the fuel cell 30 detected by a voltmeter 40, and processing of [current I] which was read / predetermined current Ian] are repeated (Step S300 - S304). Here, predetermined current Ian is the same as that of the predetermined current Ian in the humidification state judging processing routine of drawing 3.

[0056] If Current I is in agreement with predetermined current Ian, voltage V will be substituted for voltage V0 as it is (Step S306), and processing which reads the voltage V of the fuel cell 30 again detected by a voltmeter 40 is performed (Step S308). And differentiation value dV/dt is computed by breaking what subtracted voltage V0 from the read voltage V this time by minute time delta t (Step S310). Minute time delta t is what is set up as time required by reading of the voltage V of Step S308 from reading of the voltage V of the step S3[illegible] in case Current I is in agreement with predetermined current Ian here. It is the same as that of minute time delta t in the humidification state judgment processing routine of drawing 4 to be set by the mode in which a parallel processing is carried out by performance [of CPU52 of the electronic control unit 50] and CPU52. In addition, although there is also a point which calls it like [dV/dt : differentiation value] differentiation value dV/dt, it will be similarly called a differentiation value.

[0057] If differentiation value dV/dt is calculated, calculated differentiation value dV/dt will judge whether it is in the proper humidification range set up with a threshold gamma and a threshold delta (Step S312). Since voltage V drops gradually even if humidifying becomes still more insufficient when humidification of the electrolyte membrane 32 is insufficient since evaporation of moisture of the electrolyte membrane 32 is promoted by increasing the amount of supply of oxidation gas, differentiation value dV/dt serves as a small value. On the other hand, since evaporation of moisture of the electrolyte membrane 32 is promoted by the increase in the amount of supply of oxidation gas and it becomes close to proper humidification when humidification of the electrolyte membrane 32 is superfluous, change of proton conductivity also becomes large and differentiation value dV/dt also serves as a big value. Therefore, differentiation value dV/dt in case the humidification state of the electrolyte membrane 32 is in the proper range is calculated. While making that minimum into a threshold gamma, the humidification state of the electrolyte membrane 32 can be judged by carrying out proper humidification determination of that maximum as a threshold delta, and comparing computed differentiation value dV/dt with this range.

[0058] "Proper humidification" is made into a judgment result when computed differentiation value dV/dt is in the proper humidification range (Step S314). When differentiation value dV/dt is below the threshold gamma, "a shortage of humidification" is made into a judgment result (Step S316), and when differentiation value dV/dt is more than the threshold delta, this routine is ended by making "superfluous humidification" into a judgment result (Step S318).

[0059] According to the fuel cell system 20 of a work example which performs the humidification state judging processing routine of drawing 6 explained above, the humidification state of the electrolyte membrane 32 can be judged based on the voltage V outputted from the fuel cell 30 when increasing the amount of supply to the fuel cell 30 of oxidation gas, and the voltage V outputted from the fuel cell 30.
[0060] By the humidification state processing judging routine of this drawing 6, although only the amount of supply to the fuel cell 30 of oxidation gas was increased, it is good also as what increases the amount of supply to the fuel cell 30 of fuel gas with the increase in the amount of supply to the fuel cell 30 of the oxidation gas.
[0061] Next, the humidification state judging processing routine illustrated to drawing 7 is explained. If this routine is performed, CPU62 will read the voltage V outputted from the fuel cell 30 and detected by a voltmeter 40 (Step S400), and will substitute the read voltage V for voltage V0 last time (Step S402). And the amount of supply to the fuel cell 30 of oxidation gas is increased (Step S404), and processing which reads the voltage V of the fuel cell 30 again detected by a voltmeter 40 is performed (Step S406). And voltage deviation deltaV is computed by subtracting voltage V0 from the read voltage V this time (Step S408).
[0062] If voltage deviation deltaV is computed, it will be investigated whether the value of this voltage deviation deltaV is a negative value (Step S410). When voltage deviation deltaV is zero or more values, "proper humidification" is made into a judgment result (Step S412), and when voltage deviation deltaV is a negative value, this routine is ended by making "insufficiency of humidification" into a judgment result (Step S414). This judgment is through evaporation of moisture of the electrolyte membrane 32 is promoted by increasing the amount of supply to the fuel cell 30 of oxidation gas. When the electrolyte membrane 32 is in proper humidification, even if evaporation of a certain amount of moisture is promoted, it is based on the voltage V which change is not seen, but it becomes still more insufficient when humidification of the electrolyte membrane 32 is insufficient humidifying it, and is reflected to the voltage V outputted from the fuel cell 30 from the fuel cell 30 becoming small.
[0063] According to the fuel cell system 20 of a work example which performs the humidification state judging processing routine of drawing 7 explained above, the humidification state of the electrolyte membrane 32 can be judged based on the voltage V outputted from the fuel cell 30 when increasing the amount of supply to the fuel cell 30 of oxidation gas.
[0064] By the humidification state processing judging routine of this drawing 7, although only the amount of supply to the fuel cell 30 of oxidation gas was increased, it is good also as what increases the amount of supply to the fuel cell 30 of fuel gas with the increase in the amount of supply to the fuel cell 30 of the oxidation gas.
[0065] Next, the humidification state judging processing routine illustrated to drawing 8 is

explained. In the fuel cell system 20 which performs the humidification state judging processing routine, the voltmeter 40 attached to the fuel cell 30 needs to be what can detect the voltage of each single battery 31 which constitutes the fuel cell 30. A voltmeter 40 is installed respectively as what detects the voltage V of each single battery 31 of the fuel cell 30. [0056] If the humidification state judging processing routine of the drawing 7 is performed, CPU62 will read the voltage V of each single battery 31 which constitutes the fuel cell 30 first detected by a voltmeter 40 (Step [illegible]), and will calculate distributed signal1 of each read voltage V (Step [illegible]). Then, the amount of supply to the fuel cell 30 of oxidation gas is increased (Step [illegible]), the voltage V of each single battery 31 again detected by a voltmeter 40 is read (Step [illegible]), and distributed signal2 of each read voltage V is calculated (Step [illegible]).

[0057] And the calculated distribution signal1 and signal2 are compared (Step [illegible]). When distribution signal2 is less than distributed signal1, "proper humidification" is made into a judgment result (Step [illegible]), and when distributed signal2 is larger than distributed signal1, this routine is ended by making "overhumidification" into a judgment result (Step [illegible]). By increasing the amount of supply to the fuel cell 30 of oxidation gas, by promoting evaporation of moisture of the electrolyte membrane 32, the electrolyte membrane 32 in the state where humidification is superfluous approaches a proper humidification state, and this judgment is based on the variation in the voltage V of each single battery 31 becoming small.

[0058] According to the fuel cell system 20 of a 4th example which performs the humidification state judging processing routine of drawing 7 explained above, the humidification state of the electrolyte membrane 32 can be judged based on the variation in the voltage V of each single battery 31 which constitutes the fuel cell 30 before and after increasing the amount of supply to the fuel cell 30 of oxidation gas.

[0059] Although the humidification state of the electrolyte membrane 32 was judged by the humidification state processing judging routine of the drawing 7 from the variation in the voltage V of each single battery 31 which constitutes the fuel cell 30 (distribution), it is good also as what constitutes the fuel cell system 20 by two or more battery modules which consist of two or more single batteries 31, and judges the humidification state of the electrolyte membrane 32 based on the variation in the voltage of each battery module (distribution). Moreover, by the humidification state processing judging routine of drawing 7, although only the amount of supply to the fuel cell 30 of oxidation gas was increased, it is good also as what increases the amount of supply to the fuel cell 30 of fuel gas with the increase in the amount of supply to the fuel cell 30 of the oxidation gas.

[0060] As mentioned above, although the form of operation of this invention was explained using the work example, as for this invention, it is needless to say that it can carry out with the form which becomes various, within limits which are not limited to such a work example at all

and do not deviate from the essentials of the invention.

[Translation done.]